

Remarks

Claims 1-5, 7-9 and 13 are currently pending. Claims 10-12 have been withdrawn. Claim 6 has been cancelled, and Claims 1 and 13 have been amended, in accordance with the Examiner's suggestions. No new matter has been presented.

Rejections Under 35 USC 112(1)

Claims 1 and 13 stand rejected under 35 USC 112 first paragraph as failing to comply with the written description requirement. Claims 1 and 13 have been amended to remove the matter noted by the examiner as appearing to him to be drawn to new matter. Accordingly, it is submitted that that rejection has been overcome and should be withdrawn.

Rejections Under 35 USC 103(a)

Claims 1-5 and 13 stand rejected under 35 USC 103(a) as being unpatentable over Perry (US 5,919,284) in view of Williamson (US 5,480,547). Claims 6-8 stand rejected under 35 USC 103(a) as being unpatentable over Perry in view of Williamson, and further in view of Hughes (US 4,640,781). Claim 9 stands rejected under 35 USC 103(a) as being unpatentable over Perry in view of Williamson and Hughes, and further in view of Boogay (US 4,299,699).

The present invention relates to an apparatus and method for encouraging droplet growth within a fluid feed stream in which there are at least two different phases, for example, a continuous phase and a dispersed phase, a liquid phase and a non-liquid phase, or a mixture of gas phases such as in gas scrubbing applications. Preferably, the feed stream is a liquid stream comprising water and oil, or water and solvent, in which the water is a continuous phase and the oil or solvent is a dispersed or minority phase. The apparatus comprises a chamber through which the feed stream flows. The chamber has two ends, and there is an intermediate branch between the two ends. The branch has a free end at which the inlet is located, and the outlet is at one of the two ends of the chamber. The chamber contains a coalescing medium comprising a plurality of elongate members which are fibers. Only one end of each fiber is secured, at the end of the chamber opposite the outlet, and the other end of each fiber is free. The feed stream enters the inlet at the open end of the intermediate branch, flows into the chamber at a location along the length of the fibers, thence toward the outlet coming into contact with the remaining length

of the fibers, which extend in the direction of the fluid flow, and out the outlet. The interaction of the fluid flowing along the surface of the fibers causes droplets of the minority phase to grow along the length of the fibers, and the grown droplets are then carried by the flowing fluid out of the chamber. The minority phase droplets grown in the chamber can then be separated from the continuous phase in a subsequent phase separation device more easily than if the invention had not been used. For example, when used with a hydrocyclone, tests show the efficiency of the hydrocyclone can be improved by up to 90%. Since the feed stream does not encounter any obstacles in the chamber and the fibers are oriented in the flow direction, there is little flow resistance created, which is important when the invention is used in a low pressure process train. The coalescing medium is secured to a retaining member that can be accessed via an access cover, to allow cleaning, removal, or replacement of the retaining member and coalescing medium, such as for maintenance, or to exchange one type of medium for another.

In contrast, Perry is directed to a gas filter separator coalescer and multi-stage vessel. The Examiner describes Perry as disclosing “the structure of the apparatus substantially as claimed” (page 2 of the Office Action). However, Perry is easily distinguished from the invention of the present application. It is true that Perry discloses a vessel with an inlet and an outlet containing a coalescer, superficially appearing somewhat like the present invention, but there the similarity ends. Unlike the present application, Perry discloses a partition 59 located within the vessel interior that divides the vessel into a first stage and a second stage, an inlet baffle 69, an outlet baffle 71, and filter elements 61, all of which present obstacles to the feed stream and create a rise in pressure between the inlet and the outlet. (Perry column 3 line 59 – column 4 line 28, column 5 lines 54 - 59). This is precisely the opposite of the present invention, where the feed stream does not encounter any obstacles in the chamber and there is little resistance to the feed stream.

Furthermore, the coalescing medium of Perry is substantially different from that of the present invention. The coalescing medium of the present invention comprises a plurality of mutually aligned elongate members extending in the flow direction, secured at only one end and free to extend along the flow direction under the action of the feed stream, thereby causing droplets of a minority phase in the feed stream to coalesce. In the present invention, the feed stream may be liquid. In stark contrast, Perry discloses a separator/coalescing filter element for use only with a gaseous feed stream, and which has sidewalls and a hollow core, supported at the

middle and at both ends and not free to extend under the action of the feed stream. The filter has a density and porosity selected to prevent solids and “pre-coalesced” liquids from passing through, thereby removing solids and liquids from the gaseous feed stream. (Perry column 4 lines 29 – 33). In addition, Perry comprises flow diffusers 75, which prevent droplets from being re-entrained into the gas stream. (Perry column 4 line 57 – column 5 line 3). Thus, the filter of Perry is designed to permit a gas to pass through but to hinder the free passage of a liquid, or even drops of a liquid. This is exactly the opposite of the coalescer of the present invention, which is designed to allow a liquid feed stream to pass as easily as possible. In addition, Perry does not disclose or suggest coalescing members that are substantially mutually aligned fibers free to extend under the action of the fluid flowing through the chamber, as does the present invention. Instead, Perry teaches an elaborate construction of rigid elements “preferably constructed in the manner and of the materials disclosed in copending application 08/547,352”, now issued as US Patent No. 5,827,430. Those elements are made of pressed sheets having a selected porosity, comprising a binder material and formed into a shape such as a tube. Suitable filters are disclosed in Perry column 6 lines 10-40, and are dramatically different from the coalescing medium of the present invention.

The Examiner states that the claims of the present invention differ from Perry only by reciting that the chamber includes a specific access cover and shoulder. As shown above, Perry is distinguished from the claims of the present application by much more than just the access cover. Nevertheless, Williamson does teach separating liquid phases in an apparatus which is superficially similar to that of the invention, having a chamber with an inlet and an outlet, and containing a coalescing medium. However, in Williamson the fluid stream is partially blocked by a tubesheet 28, which directs the fluid stream into a housing containing the coalescing medium, and the housing is held in place by the tubesheet. This is in stark contrast with the present invention, which does not have a tubesheet or any other obstruction to the free flow of the feed stream, and does not have a separate housing holding the coalescing medium. In addition, the fluid stream must pass through a certain volume of coalescing medium in Williamson, as through a filter. The effectiveness of the coalescer in Williamson is a function of the pore size of the coalescing material through which the feed stream passes (Williamson column 8 lines 24-40). In contrast, in the present invention, the minority phase coalesces as the feed stream flows along the surface of the coalescing medium, and the coalescing medium does

not need to have any pores at all. Furthermore, the coalescing medium in Williamson is formed into sheets or webs through which the feed stream passes (Williamson column 8 lines 14-23). This contrasts sharply with the present invention, in which the coalescing medium comprises elongate members that are mutually aligned fibers.

The Examiner cites Hughes for a coalescing medium comprising elongate members to coalesce and separate liquid phases in an apparatus including fibers. Hughes discloses an expandable fibrous bed coalescer. However, Hughes discloses a support 6 having a plate 12 (Hughes column 2 lines 37-38), or alternatively an eye on the top of rod 14 (Hughes column 4 lines 9-10), to which the fibers are attached and through which the feed stream passes. The fibers are compressed between the walls of a tubular neck portion 1A of a container, thereby forming a packed fibrous bed B with a depth D, through which the feed stream passes (Hughes column 2 lines 65-68). In contrast, except for the fibers, the fluid inlet and a fluid outlet, the present invention does not include any of the elements taught by Hughes, such as separate fluid outlets for the separated fluids, the movable support 6 to which the fibers are secured, a housing with a frustoconical portion 1B and a dome-shaped upper end cap 1D, etc. Moreover, the packed fibrous bed B of Hughes constitutes a partial obstruction to the feed stream, which necessarily creates an increased pressure differential between the inlet and the outlet, and which is avoided by the present invention. Furthermore, Hughes actually teaches away from the present invention by stating that no "agglomeration" (or coalescence) of the minority phase takes place in the portion of the fibers that are not compressed (Hughes column 3 line 9). In the present invention, coalescence of the minority phase does indeed take place as the feed stream flows along the surface of fibers that are not compressed. Although the coalescing medium of Hughes comprises fibers as does the present invention, the fibers in Hughes are used in a completely different way than the fibers in the present invention.

Thus, there can be no motivation to combine the elements of Perry, Williamson, and Hughes to arrive at anything like the present invention as recited in independent claims 1 and 13 of the present application. The operative medium taught by Hughes is a packed fibrous bed of compressed fibers. In contrast, the operative medium disclosed in the present application comprises uncompressed fibers. Hughes teaches that no agglomeration (or coalescence) takes place in uncompressed fibers, but such coalescence does indeed take place in uncompressed fibers in the present invention. Furthermore, even if the arrangement of fibers in Hughes was

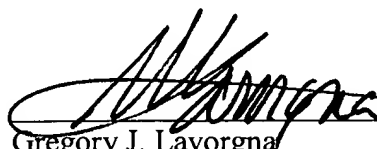
similar to the arrangement of fibers in the present invention, there is no teaching or suggestion in any of Perry, Williamson, or Hughes to combine their elements. For these reasons, combining the elements of Perry, Williamson, and Hughes in an effort to arrive at the present invention would not be obvious to one of skill in the pertinent art.

Based on the arguments presented above, withdrawal of the 35 USC 103(a) rejection of claims 1 and 13 is respectfully requested. Claims 2-5 and 7-9 depend from claim 1 and are therefore also allowable, without prejudice to their individual merits. Withdrawal of the 35 USC 103(a) rejection of these claims is also respectfully requested.

Conclusion

In view of the foregoing amendment and remarks, Applicant respectfully submits that the present application, including claims 1-5, 7-9 and 13, is in condition for allowance and a notice to that effect is respectfully requested. If the Examiner believes that any additional minor formal matters need to be addressed in order to place this application in condition for allowance, or that a telephone interview will help to materially advance the prosecution of this application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

Respectfully submitted,
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